Load carriage for emergency responders

Orr, Rob Marc; Lockie, Robert; Saari, Anssi; Paavola, Tommi; Muhlbauer, Dagmar; Dawes, Jay

DISASTER & EMERGENCY MANAGEMENT CONFERENCE

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[1]Dr Rob Orr,
[2]Dr Robert Lockie, [3]Dr Anssi Saari, [4]Tommi Paavola,
[5]Dagmar Muhlbauer, [6]Dr Jay Dawes

[1]Tactical Research Unit, Bond University, Australia
[2]California State University, Fullerton, USA
[3]Weber State University, USA
[4]New Jersey Search and Rescue, USA
[5]Durban University of Technology, South Africa
[6]Oklahoma State University, USA

Load Carriage for Emergency Responders

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CONTENT:

- Load carriage context
- Risks associated with load carriage
- Risk enhancers
- Load carriage conditioning

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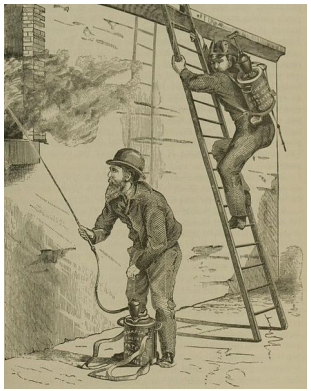
FIREFIGHTER CONTEXT

- Context and scope of practice has changed

1770

http://upload.wikimedia.org/wikipedia/commons/thumb/6/66/Old_firefighters.jpg/220px-Old_firefighters.jpg

1879



http://upload.wikimedia.org/wikipedia/commons/4/43/Vintage_firefighters.jpg

2012

http://www.stacksplace.com/EMS/ffadd1.jpg

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LAW ENFORCEMENT CONTEXT

1890s

http://2.bp.blogspot.com/-xHtSiLRFIMQ/UfewLRnEgAI/AAAAAAAAIpc/54yapn_ibtE/s1600/Curious+Black+&+White+Photographs+of+The+Police+Officers+from+1890–1930+(28).jpg

1970s

http://3.bp.blogspot.com/-HO26ffMhqS4/UiHkEhycrOI/AAAAAAAAMR4/qGsg2ryfWKA/s640/Pictures+of+Life+of+the+New+York+Police+Department+in+the+1970's+(7).jpg

http://www.gunblast.com/images/WBell_PoliceHolsterHist/Police-Holster-History-012.jpg

2010

http://images.smh.com.au/2012/12/04/3861588/art-police-uniforms-620x349.jpg

http://images.smh.com.au/2009/03/09/410908/policebelt.jpg

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LAW ENFORCEMENT CONTEXT

http://images.canberratimes.com.au/2012/06/24/3400673/art729-st24policewomen-420x0.jpg

http://img.dailymail.co.uk/i/pix/2008/04_03/TabGunGirlLEWIS_468x715.jpg

https://www.dailymail.co.uk/femail/article-6490555/Where-arrested-Three-young-female-police-officers-set-internet-alight.html

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EMS CONTEXT

https://www.ems1.com/ems-advocacy/articles/10-best-reasons-to-join-and-stay-in-ems-7k7el8xdUpCEJYNp/

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SAR CONTEXT

http://bloximages.newyork1.vip.townnews.com/estesparknews.com/content/tncms/assets/v3/editorial/d/c7/dc7f6316-1ea7-11e5-a8eb-bb1f7936f02c/5591bc1ee90b6.image.jpg

http://www.medicinec.si/wp-content/uploads/2013/10/imgS1351803309img5092e1ada9b3c.jpg

http://www.sandia.gov/news-center/news-releases/2004/images/SAR-map.gif

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SAR CONTEXT

Conolly et al., 2015

- Prolonged hiking with loaded backpack (30–50 lbs), helmet, and harness in mountainous terrain
- Litter loads can be in excess of 100 lbs
- Maintain squat or semi-squat position with around 17% BW load.

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RISKS ASSOCIATED WITH LOAD CARRIAGE

- Injuries: Associated with a variety of injuries (from skin blistering to muscle, ligament, tendon, bone and nervous system injuries)

https://www.reddit.com/r/MedicalGore/comments/9s02i6/soldiers_feet_after_walking_around_in_tight_boots/

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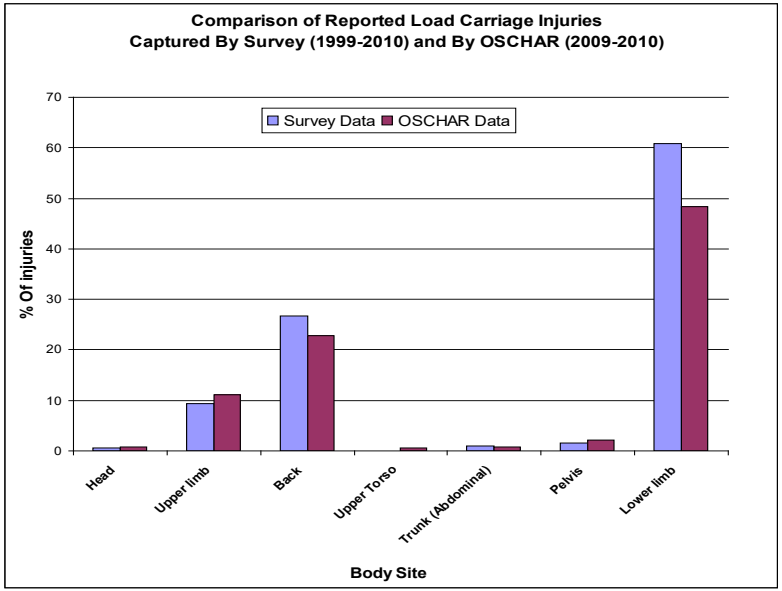
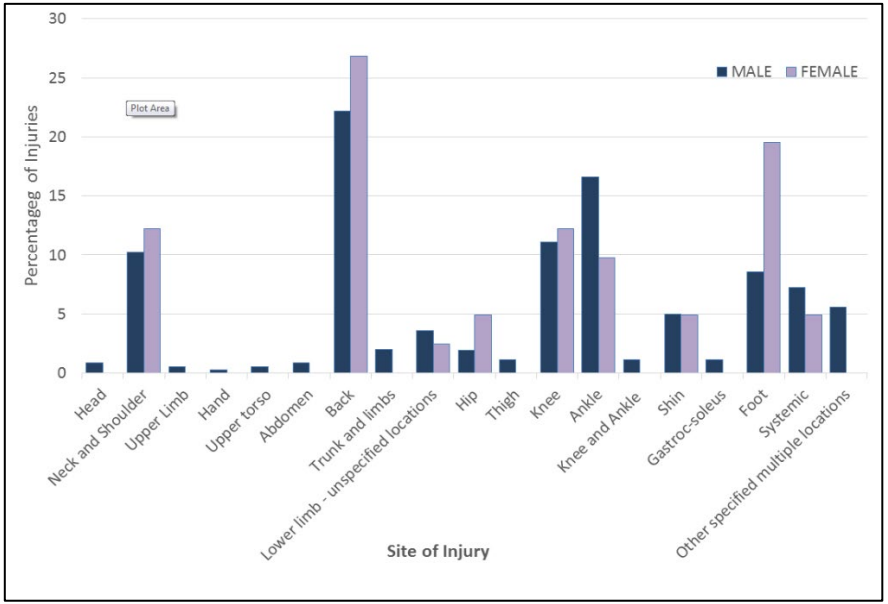
RISKS ASSOCIATED WITH LOAD CARRIAGE

- Some differences may exist between genders





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RISKS ASSOCIATED WITH LOAD CARRIAGE

- No literature has been found to specially investigate load carriage injuries in SAR. However, **musculoskeletal injuries consisting of sprains, strains, fractures, and dislocations to shoulder, knee, ankle, and fingers** have been reported as injury natures and sites in SAR personnel (Conolly et al., 2015; Iserson, 1989).

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RISKS ASSOCIATED WITH LOAD CARRIAGE

- Decrements in performance:
  - ↓ Mobility
    - Increased risk of trip and fall
    - Decreased ability to negotiate escape routes

http://mountainenterprise.com/fds/images/story/fs_4764.jpg

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RISK ENHANCING FACTORS

- ↑ in load weight = ↑ in the energy cost of standing, walking (forwards and backwards, up and down stairs) and running
- ↑ in speed of load carriage = ↑ in the energy cost of carrying given load (more than weight)? ↑ *0.5km/h= ↑10kg*

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RISK ENHANCING FACTORS

- ↑ in gradient of load carriage = ↑ in the energy cost of carrying given load (more than weight)?
  ↑ *1%= ↑10kg*

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RISK ENHANCING FACTORS

- Different terrains types will elicit different energy cost requirements

  (road-light brush-heavy brush-sand)

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RISK ENHANCING FACTORS

- Differences in load placement will elicit differences in energy cost.
  - Weight on the feet more costly than the back
  - Thigh more costly that back (0.5kg ↑ cost by 3.5%)
  - Shoulder more costly than back
  - Hands around 2 x more costly than back*

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RISK ENHANCING FACTORS

- Soule and Goldman (1969) found the cost of carrying a 7 kg load in the hands to be nearly twice that of carrying the load on the torso.
- Datta and Ramanathan (1971) observed a significantly higher ($p<.05$) cost of load carriage in the hands (mean of 6.96 KCAL/min) than on the back (mean of 5.27 KCAL/min).

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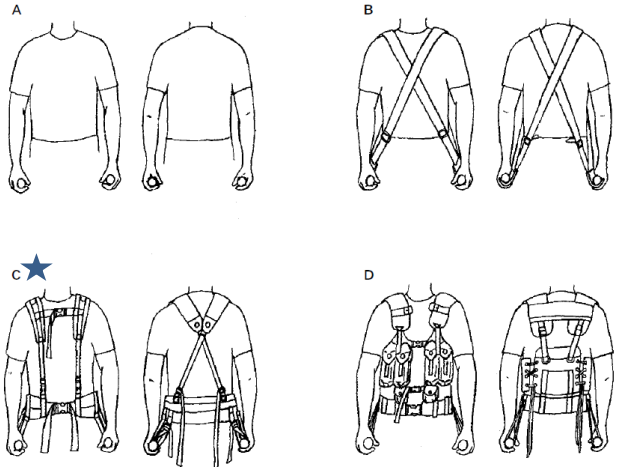
RISK ENHANCING FACTORS

- Knapik et al., 2000
  - Load carriage times were significantly shorter when loads were carried in the hands (81 – 88%; p<.01) when compared to the innovative methods.

http://woodheadmrt.org/wp-content/uploads/2015/09/woodheadmrt1200.jpg



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RISK ENHANCING FACTORS

- Unilateral v Bilateral Loads in the hand
  - Unilateral hand loading can:
    - increase hip muscle activity to twice that for the same load carried bilaterally (Neumann, Cook, Sholty, & Sobush, 1992),
    - cause gait asymmetry (Zhang, Ye, & Wang, 2010) and
    - potentially increase further energy expenditure (Datta & Ramanathan, 1971).

http://www.grough.co.uk/lib/img/editorial/caldervalleyhardcastlerescue.jpg

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LOAD CARRIAGE CONDITIONING

- Concept is not new (*Flavius* Vegetius Renatus - *Epitoma rei militaris)*
- Common in military training but in SAR?

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LOAD CARRIAGE CONDITIONING

Research by Orr et al. (2010) and Knapik et al., (2012) recommend:

- F.I.T.T Formula (Frequency, Intensity, Time & Type)
  - F. 7-10 days per load carriage session
  - I. To loads required at the speeds and over the terrains required
  - T. Duration of load carriage operations
  - T. Load carriage preferable, but combined resistance and cardio may be of some benefit

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LOAD CARRIAGE CONDITIONING

- Specificity

http://www.grough.co.uk/lib/img/editorial/KirkbystephenCautley-Spout-2.jpg

http://blog.nhstateparks.org/wp-content/uploads/2012/04/Search-Rescue-litter-passing-over-rough-terrain.jpg

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Take Home Messages

- Load carriage reduces performance and can cause injuries = decreased operational success
- Load carriage is about more than the load weight, terrain type and grade, speed of movement and load position must be taken into account
- To minimise the risk of injury and increase the potential for operational success SAR personnel need to be conditioning to carry load

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